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山东中新世山旺植物群中豆荚属的名实问题

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On the identity of *Podogonium* Heer 1857, nom. illeg. (Leguminosae) from the Miocene Shanwang flora of Shandong

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Abstract The nomenclature and taxonomy of *Podogonium* Heer 1857, nom. illeg., a legume fossil widely distributed in the Neogene of Eurasia, were briefly reviewed. Herendeen's viewpoint that *Podogonium* Heer 1857 is a later synonym of *Podocarpium* A. Braun ex Stizenberger 1851 is supported. The genus possibly contains only one species, *Podocarpium podocarpum* (A. Braun) Herendeen 1992. *Podogonium* Heer 1857 should be no longer used as a conserved name. The specimens from the Miocene Shanwang flora of Shandong, which had been previously referred to *Podogonium oehningense* (Koenig) Kirchh. and *P. knorrii* (Braun) Heer, were re-investigated. The results suggest that these specimens are the same plant as the legume fossil from European *Podocarpium podocarpum* (A. Braun) Herendeen.

Key words Leguminosae, *Podogonium* Heer 1857, *Podocarpium* A. Braun ex Stizenberger 1851, *Podocarpium podocarpum* (A. Braun) Herendeen 1992, Shanwang flora, Miocene.

摘要 简要回顾了欧亚新近系广泛分布的豆科化石植物豆荚属*Podogonium* Heer 1857, nom. illeg.的命名和分类。作者基本赞同Herendeen 1992年的观点, 即*Podogonium* Heer 1857是*Podocarpium* A. Braun ex Stizenberger 1851一个晚出的异名。该属可能仅含有一个种——柄豆荚*Podocarpium podocarpum* (A. Braun) Herendeen。同时, *Podogonium* Heer 1857也不宜作为保留名继续使用。作者重新调查了山东中新世山旺植物群中过去被鉴定为*Podogonium oehningense* (Koenig) Kirchh.和*P. knorrii* (Braun) Heer的标本, 认为它们与欧洲发现的豆荚属应该为同一种植物, 即柄豆荚。

关键词 豆科; 豆荚属; 柄豆荚; 山旺植物群; 中新世

豆荚属*Podogonium*是Heer(1857)基于德国南部奥宁根(Oehningen)地区中新世地层发现的豆科Leguminosae植物的花、果、种子以及叶化石而建立的, 以后广泛发现于欧亚新近系, 尤其是中新世的植物群(Hantke, 1954; Bůžek, 1971; WGCPC, 1978; Herendeen, 1992a, b; Guo & Zhou, 1992; 刘裕生, 郑亚惠, 1995; Liu et al., 2001; Kovar-Eder et al., 2004)。该属在我国的山东、山西、江苏、浙江、安徽、广西、青海、四川和云南等地的新近系地层亦被广泛报道(Hu & Chaney, 1940; WGCPC, 1978; 郭双兴, 1980; 李浩敏,

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1981; 李浩敏等, 1987; Guo & Zhou, 1992; 刘裕生, 郑亚惠, 1995; 孙博, 1999; 陶君容, 2000)。过去, 古植物学家对这种化石植物的分类意见并不一致, 在许多不同的属名(如水盾草属*Cabomba* Aublet、黄檀属*Dalbergia* L.、皂荚属*Gleditsia* L.、似豆属*Leguminosites* Bowerbank、*Podogonium* Heer和*Podocarpium* A. Braun ex Stizenberger等)之下对其进行了描述(Stizenberger, 1851; Heer, 1857; Schimper, 1874; Chaney, 1933; Hantke, 1954; Bůžek, 1971; Gregor & Hantke, 1980; Herendeen, 1992a)。Herendeen(1992b)在详细讨论了豆荚属的命名和分类后, 指出该属的正确名称应该是*Podocarpium* A. Braun ex Stizenberger 1851, 仅含有一个种, 即*Podocarpium podocarpum* (A. Braun) Herendeen。作者认为Herendeen对豆荚属的分类处理是比较正确的, 但该属是否为单种属尚不能完全确定。我国近来有关豆荚属的古植物学文献中并没有考虑Herendeen(1992b)的意见, 仍然沿用了过去的属名*Podogonium*(刘裕生, 郑亚惠, 1995; 孙博, 1999; 陶君容, 2000), 属下种名也使用得比较混乱。最近, 作者在研究山东临朐县山旺组(中中新世)的一些豆科植物化石时, 发现其中的一些标本被命名为*Podogonium oehningense* (Koenig) Kirchh.和*P. knorrii* A. Braun。通过仔细比较, 作者认为这些标本应归为一个种, 而且它们与欧洲发现的豆荚属为同一种植物, 即柄豆荚(或单籽豆)*Podocarpium podocarpum* (A. Braun) Herendeen 1992。结合Herendeen(1992b)的意见和Liu等(2001)的最新发现, 本文讨论了山东山旺植物群中豆荚属的名实问题, 并重新描述了这些标本。

1 名实问题

欧洲的豆荚属最初根据采自德国南部奥宁根地区的果化石鉴定为睡莲科Nymphaeaceae水盾草属的种*Cabomba oehningense* Koenig (Kirchheimer, 1957), Braun (1851)将这种化石归入一个新属*Podocarpium*(Stizenberger, 1851), Koväts(1856)又将其归入豆科的*Copaifera* L.属。Heer(1857)则认为这些化石与*Copaifera*不同, 后者的果柄较短, 且二者小叶叶脉相差甚远。此外, Heer(1857)也没有采纳Braun的新属*Podocarpium*, 由于这个名字与罗汉松科Podocarpaceae罗汉松属*Podocarpus* L' Hér. ex Pers.的拼写太相似了, 他就另建了一个新属*Podogonium* (Herendeen, 1992a, b)。根据命名优先律原则, *Podogonium*是一个不合法的名字, 应该是*Podocarpium*的晚出异名, 但是, 一些作者考虑到*Podogonium*在发表后已被使用了上百年, 建议或同意将它作为保留名(Bůžek, 1971; 李浩敏等, 1987)。然而, Herendeen(1992a, b)在详细讨论了豆荚属的命名和分类问题后发现, 前面提及的*Cabomba oehningense* Koenig没有明确的发表日期, 因而不是一个有效发表的名字。同时, Braun(1851)描述*Podocarpium knorrii*所依据的标本保存地点未知, 因此也是一个不合法的名字。这样一来, 即使将*Podogonium*作为保留名继续使用, 其属下常用的2个种名(即*Podogonium oehningense*和*P. knorrii*)也是不合法的, 因为用于描述它们的模式标本都无从查证。因此, 保留*Podogonium*这个名字并不能使这些化石的命名保持稳定。由于Gregor和Hantke(1980)在将*Podogonium* Heer归入现生皂荚属时, 他们从Heer的原始材料中为*Gleditsia knorrii*指定了一个后选模式(lectotype)(即*Podogonium knorrii* (Braun, 1851) Heer, 1857: pl. 135, fig. 21; 标本号: PL398=B803), 这个标本(为果化石)与另外一个由Braun(1845)命名为*Gleditschia podocarpa*的标本实际上是相同的材料(注:

Gleditschia=*Gleditsia*), 但是根据皂荚属与豆荚属的果和叶结构特征的明显差异, Herendeen(1992a)认为这个标本不属于皂荚属, 而应归入豆荚属。因此, *Gleditschia podocarpa* Braun和*Podocarpium knorrii* Braun应该是同物异名。Heer(1857)特地将*Gleditschia podocarpa*和*Podocarpium knorrii*都作为*Podogonium knorrii*的异名处理, 而描述这些分类单位的材料都是来自同一产地, 即奥宁根地区。于是, Herendeen(1992b)重新组合了一个名字*Podocarpium podocarpum*, 并提议将Gregor和Hantke(1980)给*Gleditsia knorrii*的后选模式重新指定为*Podocarpium*的新模式(neotype)。这样既遵循了国际植物命名法规中命名的优先律, 又确保了该植物化石的合格发表。

值得一提的是, *Podocarpium* (Benth.) Yang & Huang这个名称曾被用作豆科长柄山蚂蝗属的属名(杨衔晋, 黄普华, 1979, 1995), 其模式为*Podocarpium podocarpum* (DC.) Yang & Huang 1979。近来, Ohashi和Mill(2000)重新讨论了长柄山蚂蝗属的命名和分类, 指出*Podocarpium* (Benth.) Yang & Huang与两个更早的名称(即*Podocarpium* A. Braun ex Stizenberger 1851和*Podocarpium* Unger 1864)是异物同名, 于是他们为长柄山蚂蝗属建议了一个新的属名*Hylodesmum* H. Ohashi & R. R. Mill。同时, Ohashi和Mill (2000)指出*Podocarpium podocarpum* (A. Braun) Herendeen是*Podocarpium podocarpum* (DC.) Yang & Huang一个晚出的双重异物同名(double-homonym), 考虑到后者为不合格发表的名称, 他们认为可以保留前者, 但是提出保留*Podocarpium* Unger可能比 *Podocarpium* A. Braun ex Stizenberger更好。然而, *Podocarpium* Unger已用于描述裸子植物罗汉松科的木材化石(Herendeen, 1992a), 所以笔者认为最好还是保留*Podocarpium* A. Braun ex Stizenberger。

山东山旺植物群中豆荚属的标本包括叶和果(图1: A–D)以及相关的种子化石, 经常被鉴定为*Podogonium oehningense* (Koenig) Kirchh.(WGCPC, 1978; 孙博, 1999)和*P. knorrii* (Braun) Heer (Hu & Chaney, 1940; 陶君容, 2000)。综上所述, 这些名字都是不合法的, 应该被废弃。通过比较, 作者认为山旺植物群中豆荚属的标本应该为同一种植物, 它们与欧洲发现的同属化石(Bůžek, 1971; Herendeen, 1992a)没有本质区别, 产出地层(距今1500–1700万年)(李浩敏, 1981; Yang & Yang, 1994)也可以与欧洲同期地层横向比较。因此, 山东山旺植物群中过去鉴定为*Podogonium oehningense* (Koenig) Kirchh.和*P. knorrii* A. Braun的标本应该被归为一个种, 即柄豆荚(或单籽豆)*Podocarpium podocarpum* (A. Braun) Herendeen 1992。需要说明的是, 中国其他产地报道(郭双兴, 1980; 李浩敏等, 1987; Guo & Zhou, 1992; 陶君容, 2000)的豆荚属标本也应归入这个种。

许多古植物学家都认为豆荚属化石同豆科植物有亲缘关系。Herendeen(1992a)基于果和叶结构的比较形态学研究认为, 豆荚属可能是一个与豆科云实亚科Caesalpinioideae的Detarieae或Amherstieae族中的几个属有密切亲缘关系的绝灭类群。然而, 基于相关的花粉(Mohr & Gregor, 1984)和该属可能的花化石证据, Liu等(2001)则认为豆荚属作为一种绝灭的豆科植物与云实亚科中现存属的差别较大, 它在豆科系统发育中可能处于靠近基部的位置。

2 豆荚属的重新描述

豆荚属(豆科Leguminosae)

Podocarpium A. Braun ex Stizenberger 1851 in Ueber. Verstein. Groß. Baden: 90. 1851; Herendeen in Taxon 41: 732. 1992; Y. S. Liu et al. in Palaeont. Abt. B 256: 162. 2001, non *Podocarpium* Unger in Hochstetter et al., Paläont. Neu-Seeland: 13, pl. 5, fig. 1a–c. 1865. Type: *P. dactyloides* Unger (post Nov. 1864, fossil *Podocarpaceae*), nec *Podocarpium* (Benth.) Yang & Huang in Bull. Bot. Lab. North-East. Forest. Inst. 4 (4): 4. 1979; et in Fl. Reip. Pop. Sin. 41: 47. 1995. nom. illeg. Type: *Desmodium podocarpum* DC.=*Podocarpium podocarpum* (DC.) Yang & Yang.

Podogonium Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 113. 1857. Type: *Podocarpium knorrii* A. Braun ex Stizenberger, nom. illeg. (repository unknown).

柄豆荚(单籽豆) 图1: A–D

Podocarpium podocarpum (A. Braun) Herendeen in Taxon 41: 732. 1992; Y. S. Liu et al. in Palaeont. Abt. B 256: 162. 2001; Kovar-Eder et al. in Ann. Naturhist. Mus. Wien 105 A: 74. 2004, non *Podocarpium podocarpum* (DC.) Yang & Huang in Bull. Bot. Lab. North-East. Forest. Inst. 4 (4): 7. 1979; et in Fl. Reip. Pop. Sin. 41: 52, pl. 9, figs. 1–5. 1995, nom. illeg. (=*Hylodesmum podocarpum* (DC.) H. Ohashi & R. R. Mill in Edinb. J. Bot. 57 (2): 181. 2000). ——*Gleditschia podocarpa* A. Braun in Neues Jahrb. Mineral. Geog. Geol. Petr.-Kunde: 173. 1845. ——*Dalbergia podocarpa* (Braun) Unger in K. K. Akad. Wiss. Denkschr. Math.-Nat. Cl. 2: 185, pl. 61, fig. 14. 1851.

Podocarpium knorrii Braun ex Stizenberger in Ueber. Verstein. Groβ. Baden: 90. 1851, nom. illeg. ——*Podogonium knorrii* (Braun) Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 114, pl. 134, figs. 22–26a, pl. 135, *non* fig. 19, pl. 136, figs. 1–9. 1857, nom. illeg.; Schimper in Trait. Paléont. Vég.: 43, pl. 100, figs. 29–34. 1874; Hu & Chaney in Palaeont. Sin., N. S. A: 1, 76, pl. 50, figs. 4, 5, 7, 10, 11. 1940; Herendeen in Herendeen & Dilcher, Adv. Legum. Syst. 4 Fos. Rec.: 4, figs. 1–5, 12–20. 1992a; J. R. Tao in Evol. Late Cret.-Cenoz. Fl. China: 267, figs. 18, 19. 2000; *Gleditsia knorrii* (Heer) Gregor in Gregor & Hantke, Feddes Repert. 91: 166, pl. 10, figs. 9–12, pl. 11, figs. 2–7, pl. 12, figs. 1–15. 1980, Mohr & Gregor in Paläont. Z. 58: 191. 1984.

Leguminosites climensis Chaney in Bull. Geol. Soc. China 12 (2): 134, pl. 1, fig. 7. 1933; WGCPC in Cenoz. Pl. China, Fos. Pl. China 3: 113, pl. 90, fig. 2. 1978.

Podogonium latifolium Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 116, pl. 136, figs. 10–21. 1857.

Podogonium constrictum Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 118, pl. 136, fig. 48. 1857.

Podogonium campylocarpum Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 118, pl. 136, figs. 54, 55. 1857.

Podogonium obtusifolium Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 118, pl. 134, figs. 30–34. 1857.

Podogonium lyellianum Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 117, pl. 136, figs. 22–52. 1857; Hantke in Denkschr. Schweiz. Naturforsch. Gesellsch. 80: 73, pl. 12, figs. 11–15. 1954; *Copaifera longestipata* Kováts in Arbeiten Geol. Ges. Ungarn 1: 51, pl. 1, figs. 3, 4. 1856; *Gleditsia lyelliana* (Heer) Hantke in Gregor & Hantke, Feddes Repert. 91: 167. 1980.

Podogonium oehningense (Koenig) Kirchheimer in Laubgew. Braunk.: 412, pl. 20, fig. 90a, b, 1957; Bůžek in Rozpr. Ústr. Ústav. Geol. 36: 98, pl. 48, fig. 9, pl. 50, figs. 1–27, pl. 51, figs. 1–12. 1971; WGCPC in Cenoz. Pl. China, Fos. Pl. China 3: 112, pl. 88, fig. 5, pl. 90, fig. 2, pl. 93, figs. 4, 5, 7, *non* pl. 88, fig. 7, pl. 89, fig. 7. 1978; S. X. Guo in Acta Palaeont. Sin. 19: 408, pl. 1, fig. 9. 1980; H. M. Li in Acta Palaeont. Sin. 26: 572, pl. 2, figs. 3, 3a, 4, 8, 8a,

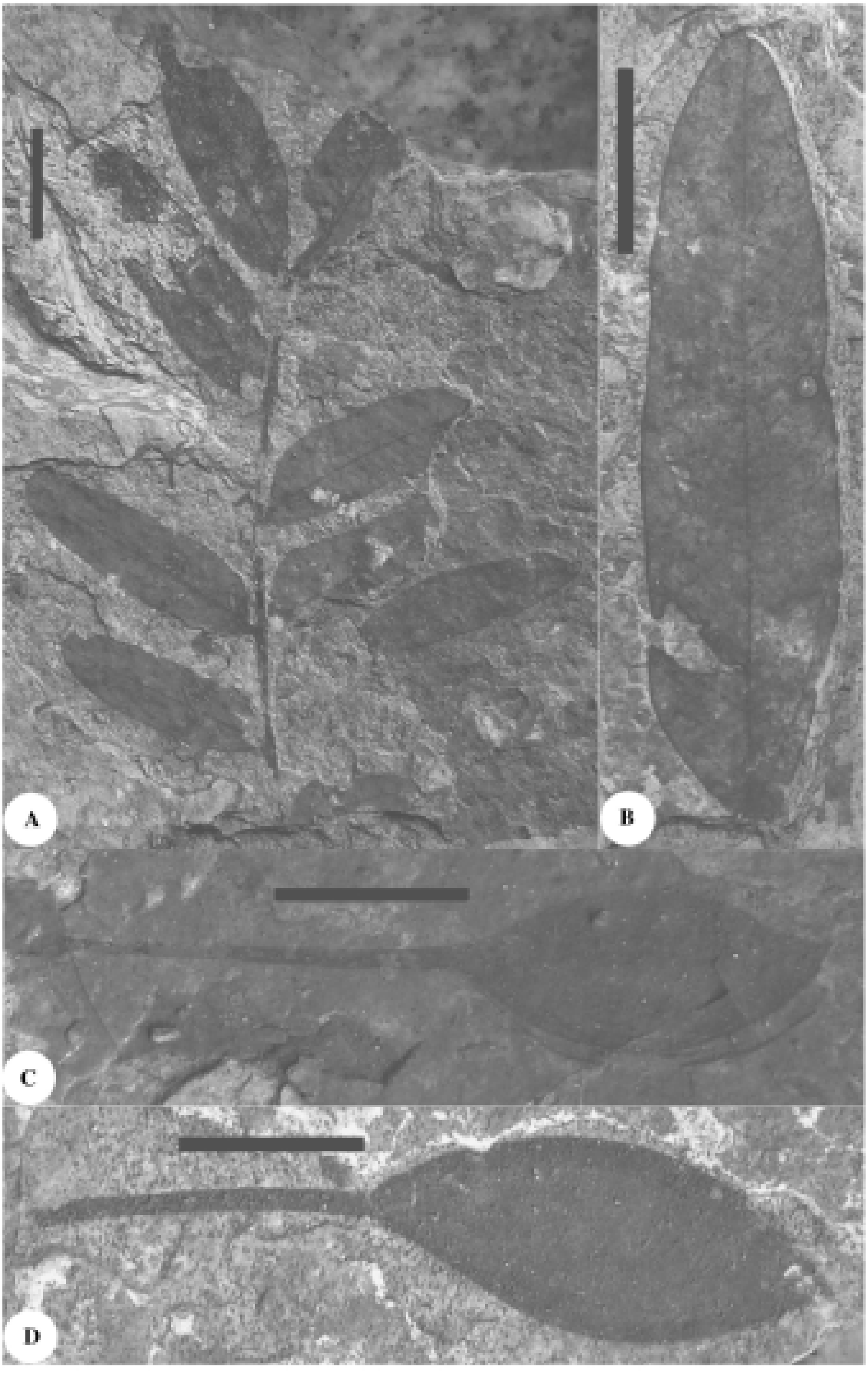

图**1**　柄豆荚的叶和果　**A.** 一片不完整的偶数羽状复叶。标本号: 50483a。**B.** 一片完整的小叶。标本号: 52463。**C.** 一枚开裂的果。标本号: 51868。**D.** 一枚未开裂的果。标本号: 52913。标尺=1 cm。

Fig. 1. Leaf and fruit of *Podocarpium podocarpum* (A. Braun) Herendeen 1992. **A,** An incomplete paripinnate leaf. Specimen number: 50483a. **B,** A complete leaflet. Specimen number: 52463. **C,** A dehiscent fruit. Specimen number: 51868. **D,** An indehiscent fruit. Specimen number: 52913. Scale bar=1 cm.

10–12, 15–19, 15a, 17a, 18a, 19a. 1987; B. Sun in Shanwang Pl. Fos. 42, 71, pl. 28, fig. 5. 1999.

Neotype: PL398=B803 (*Podogonium knorrii* (Braun, 1851) Heer in Tert. Fl. Schweiz, Fl. Tert. Helvet. 3 (6): 114, pl. 135, fig. 21. 1857). Repository: Geological Institute, Eidgenossische Technische Hochschule Zürich (ETH). Type locality: Oehningen, southern Germany. Age: Miocene.Stratigraphic range and Geographic distribution: early Oligocene to the Pliocene in Eurasia. Specimens examined herein: 50483a, 50483b, 50483c, 52463, 50508a, 50489a, 50489b, and 52058c (leaves); 2860, 52913, 51706, 52058a, 201a, 51868, 51989, 1569, 51721, and 50373 (fruits) (PE!). Locality: Shanwang Basin, Linqu County, Shandong Province, China (36°54′ N, 118°21′ E). Age: middle Miocene.

Leaves paripinnate with at least 5 pairs of opposite, rarely subopposite leaflets, up to 7.5 cm long. Leaflets sessile to short-petioluled (petiolule ca. 0.5 mm long). Lamina lanceolate, ovate to oblong-ovate, 2.0–4.4 cm long, 0.6–1.1 cm wide, margin entire, apex obtuse or acute, rarely mucronate or emarginate, base asymmetrically rounded or slightly narrowed. Midvein stout, usually straight, 1–2 prominent basal veins arising near midvein base at acute angles and extending parallel to leaflet margin. Secondary veins at 30°–70° angles, numerous, over 12 pairs, pinnately brochidodromous, forked near leaflet margin, forming angular loops. Intersecondary veins parallel to secondary veins. Tertiary veins fine, dense, forming irregular network. Fruits tardily dehiscent, 1-seeded, stalked; stalk incompletely preserved, 2–4 cm long, about 1 mm wide. Seed oblong, 12–15 mm long, 8–10 mm wide. Fruit valve with indistinct venation, elliptical, 1.8–2.8 cm long, 0.8–1.1 cm wide, apex acute, base attenuate, slightly oblique, margin not winged.

偶数羽状复叶，对生(稀近对生)，至少5对，长达7.5 cm。小叶无柄或具短柄，约0.5 mm长。叶片呈披针形、卵形或长圆状卵形，长2–4.4 cm，宽0.6–1.1 cm，全缘，顶端钝或急尖，稀突尖或凹缺，基部不对称圆形或稍狭。中脉较粗，一般直，有1–2条明显的基脉自基部以锐角从中脉延伸靠近叶缘平行朝向叶顶。二次脉多对, 12对以上，羽状弓形脉，与中脉的夹角呈30°–70°，近叶缘内分叉，环结。间二次脉与二次脉平行。三次脉细密，彼此构成不规则的脉网。荚果迟裂，内仅含1粒种子，果梗保存不完整，2–4 cm长，约1 mm宽。种子长圆形, 12–15 mm长, 8–10 mm宽。果瓣椭圆形, 1.8–2.8 cm长, 0.8–1.1 cm宽，表面纹饰不明显。果顶部急尖，基部渐狭，微偏斜，边缘无翅。

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